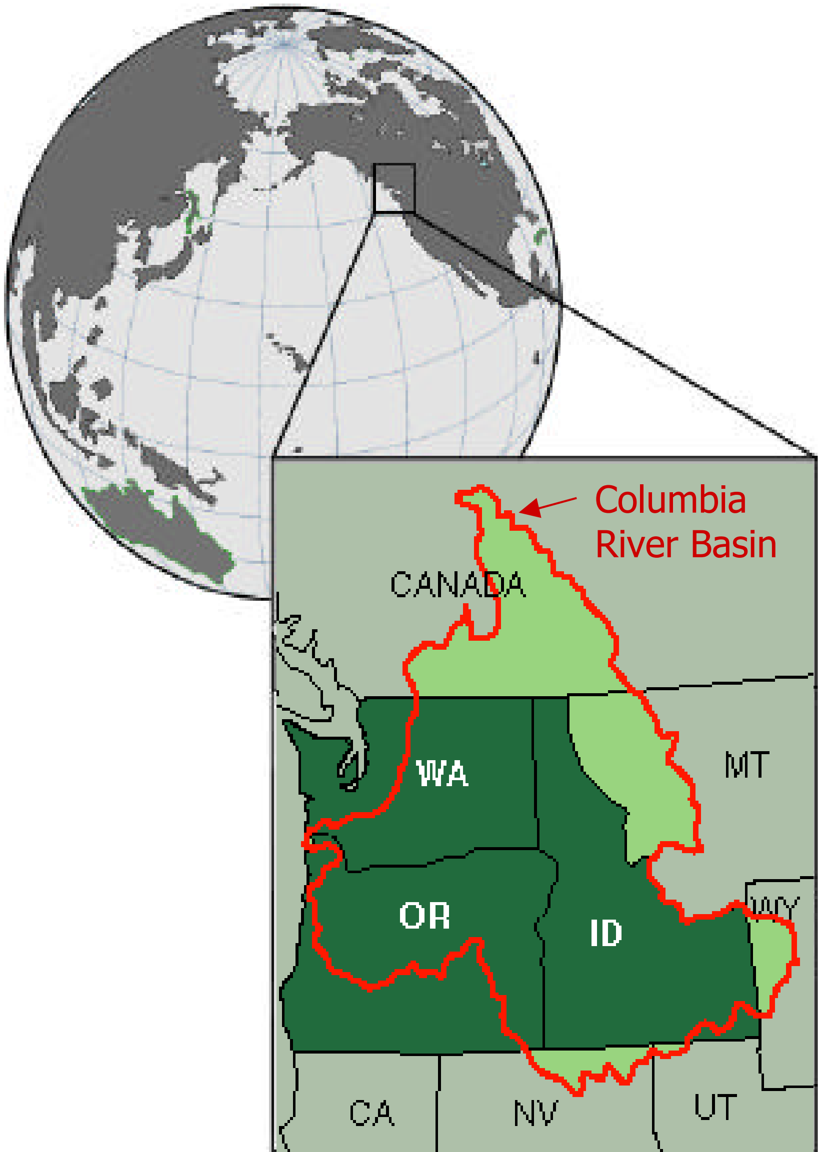


GCEP Orientation

Portland, Oregon

June 12, 2003

Bridging Science and Policy

Climate change research and outreach in the Pacific Northwest

Amy Snover, PhD

Climate Impacts Group

University of Washington

Science in Society

- Scholars have a responsibility to provide perspective on social, technological and environmental change and the challenges and opportunities they create for society.
- Much global change research motivated by a desire to contribute to this understanding, either directly (via problem-focused research) or indirectly (via exploratory research). But…
  - Researchers often frustrated because the fruits of their labors are misused, misinterpreted, or ignored.
  - Policymakers frustrated because scientists only produce useless information.

What goes wrong?

Flies in the Ointment

- Science (even more and better science) isn't always the answer

  Consider other adaptive responses

- Knowledge is power

  Attend to equity issues

- Science is better at filling decision makers' inboxes than emptying them

  Engage in a new type of science and communication

Building the Bridge

- Identifying relevant scientific research requires answering the questions: Relevant to whom? For what?

  "If scientists are serious about wanting to do research that supports decision maker needs, then they could insist on a systematic and rigorous assessment of such needs as primary input to setting research priorities…" (Pielke & Sarewitz 2002, 'Wanted: Scientific Leadership on Climate')

- Application of research results requires translation

  No more "loading dock science"

What makes knowledge usable within both society & science?

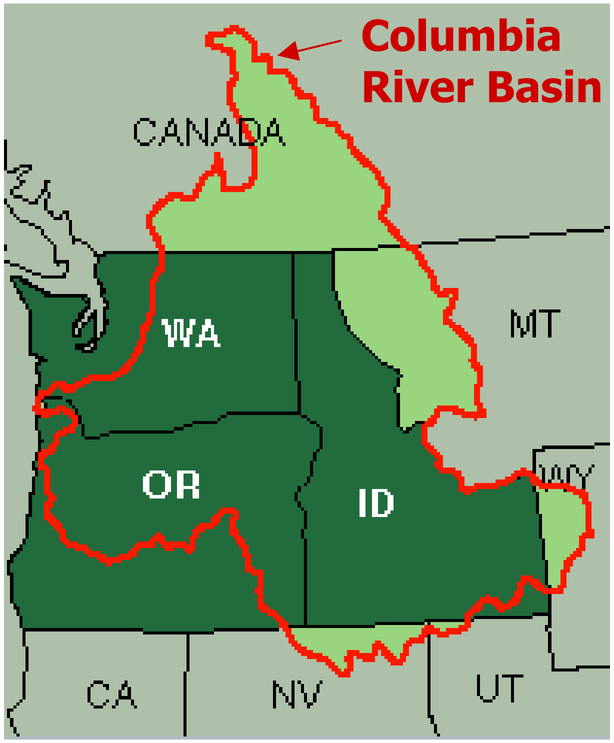
Building the Bridge I: Solution-Oriented Research

- Requires attention to “real-world” issues and constraints of decision makers…
  - Define users (“clients”)
    - Types of collaboration
    - Method of distribution
    - Technological sophistication
    - Issues of concern
  - Understand context in which information will be used
    - Time and space scales
    - Institutional, economic, and cultural circumstances in which decisions are made

- What is the real value of the information?

Requires a new type of science

The Climate Impacts Group



Areas of study:

- **Water resources**
- Salmon
- Forests
- Coasts

Motivation:

- Increase regional resilience to climate variability and change
- Produce science useful to the decision making community

An understanding of the patterns and consequences of past climate variability, policy responses and their impacts is essential for preparing for future changes in climate.

Climate Impacts Science

The study of how climate, natural resources, and human socio-economic systems affect each other

→ Requires integration of physical and social science research (UW+) & incorporation of stakeholders' perspective (federal, tribal, state, local)

Building the Bridge II:
Application Requires Translation

- Focus on usability, not just availability … no "loading dock" science
  - "value added" products
  - Diffusion of innovations
  - Capacity development
  - Evolution of "proper" relationship between science and policy

- What's the motivation for use?

Requires dialogue between scientists and stakeholders

Working with stakeholders

Target Audience:

- Resource managers
- Regulatory agencies
- Service and forecasting agencies
- Policy makers
- All levels of government
- Media
- Public

Key stakeholders:

- Federal (Bonneville Power Administration, Natural Resource Conservation Service, Army Corps of Engineers, Forest Service)
- Tribal (Columbia River Intertribal Fisheries Commission, Northwest Intertribal Fish Comm.)
- State (WA Depts of Ecology, Natural Resources, Fish & Wildlife; OR Dept of Lands (Coastal Mgmt), ID Dept of Water Resources)
- Local (Seattle Public Utilities (Water), Seattle City Light, Portland Water Bureau)

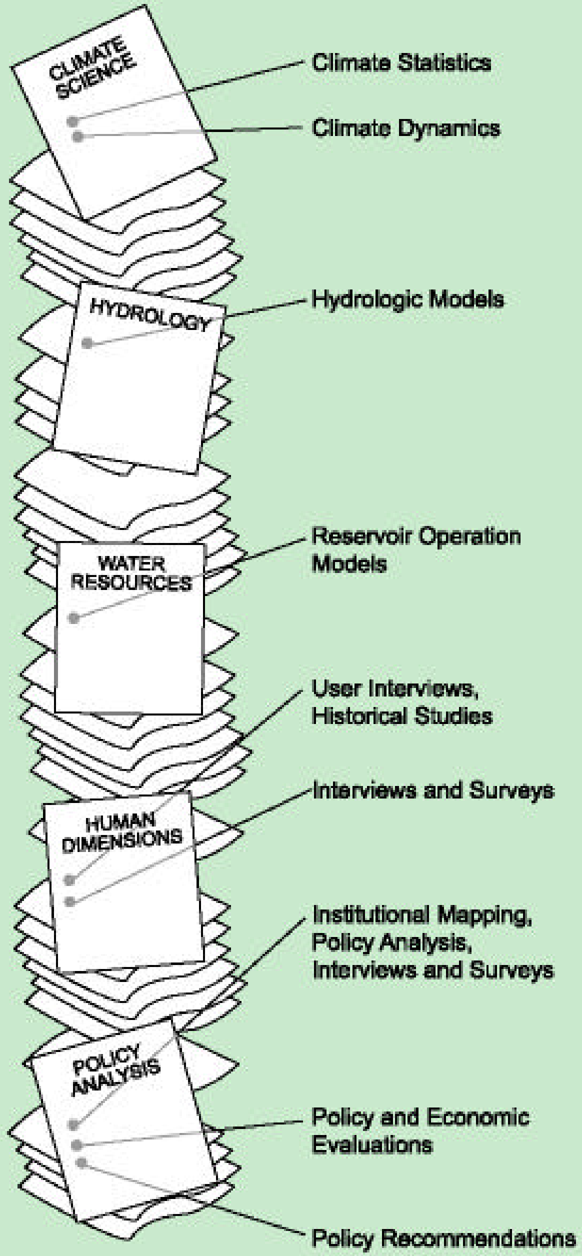
Putting into practice:

- Interviews
- Water workshops
- High-level policy meetings
- Long-term commitment

Putting It All Together: Regional Climate Impacts Assessment

An End-to-End Assessment of Climate Impacts

from CLIMATE....



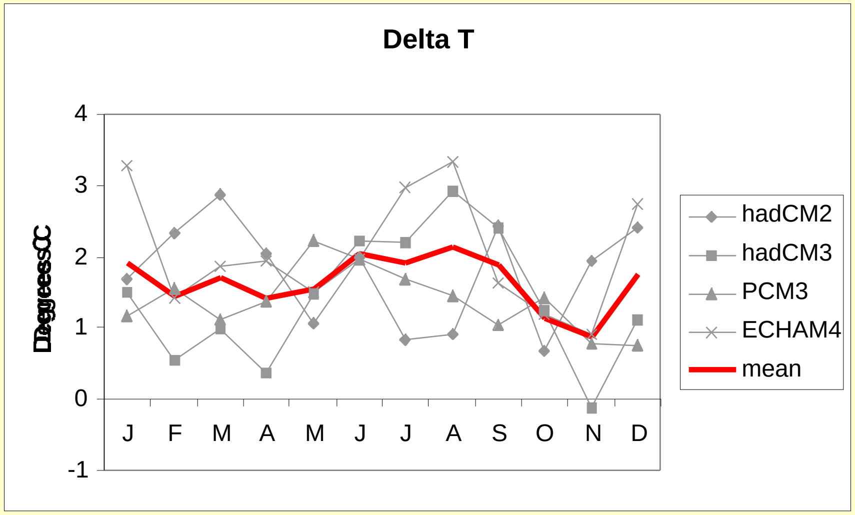
....to USER

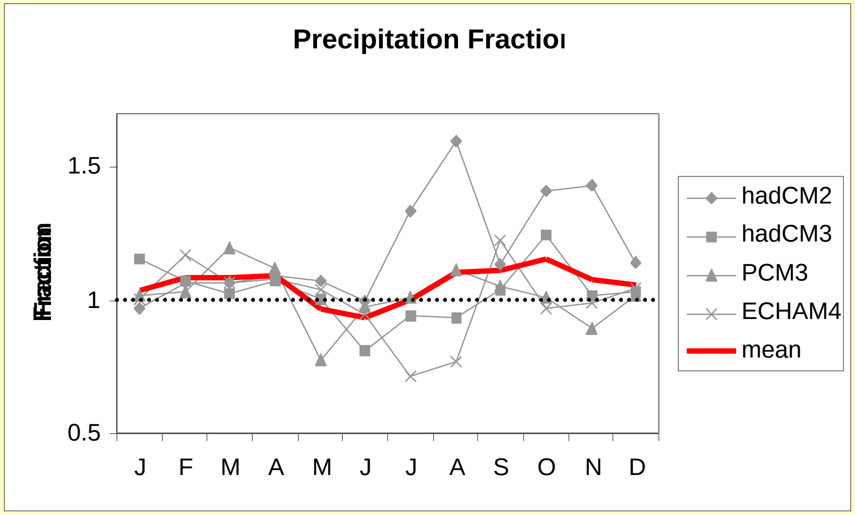
CIG's Process of Integrated Assessment:

- o Climate dynamics provides the anchor
- o Components of the assessment are undertaken in parallel, rather than in series
- o Close communication within the assessment team ensures that methods and assumptions are compatible

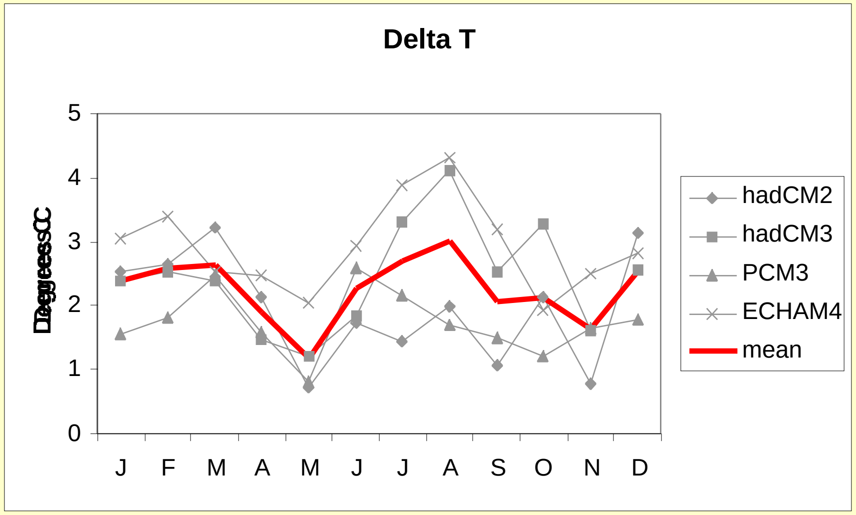
And now for the details…

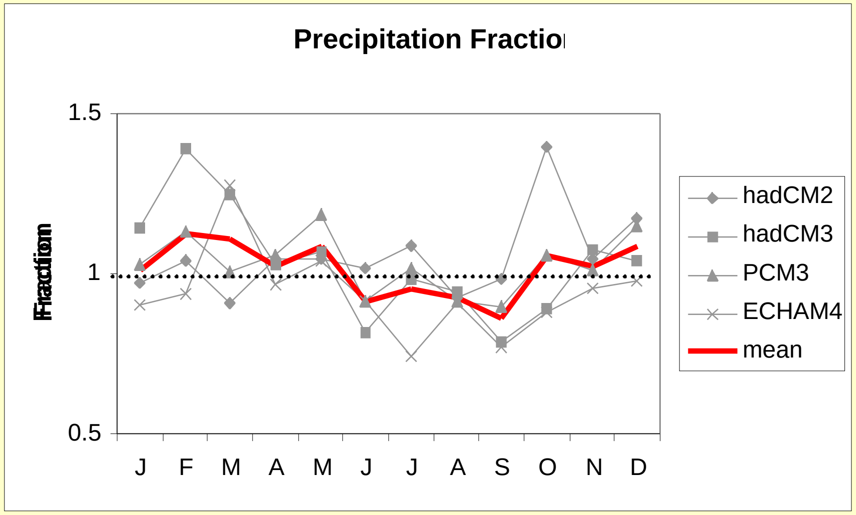
Climate Change Scenarios 2020s



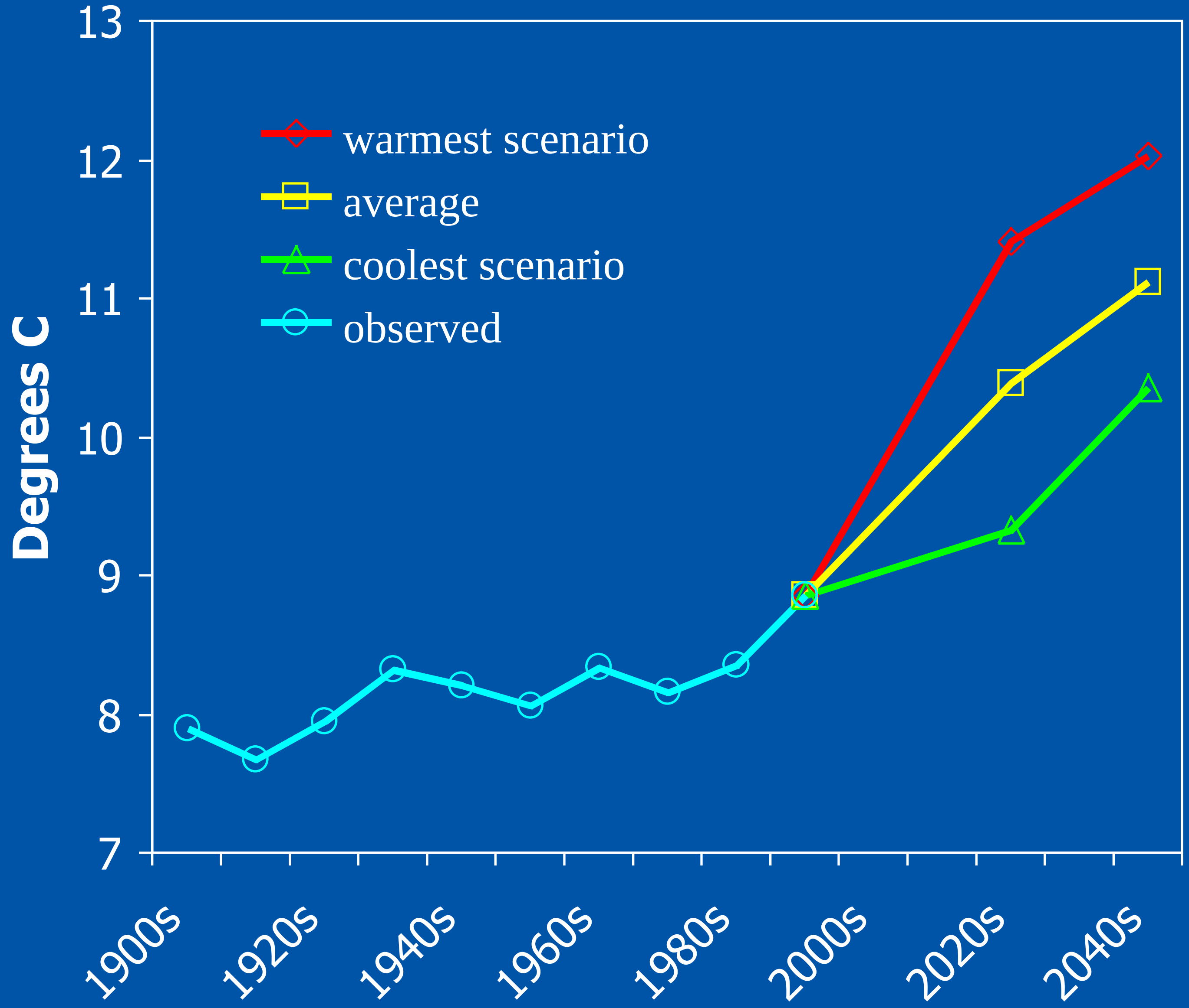


Climate Change Scenarios 2040s





Northwest warming



Despite the variability in climate change projections, all climate change scenarios examined result in similar impacts on PNW water resources.

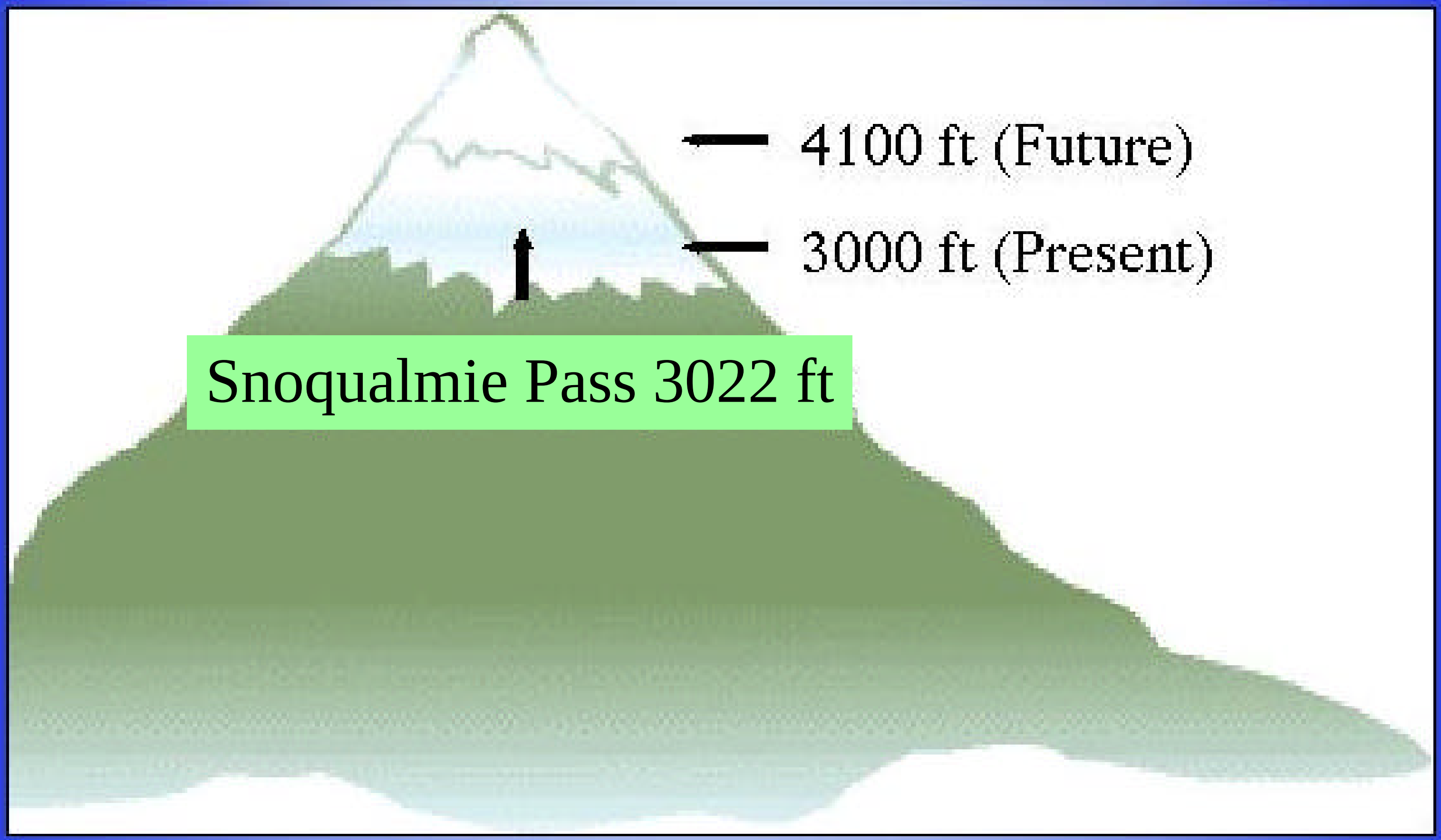
Climate change:

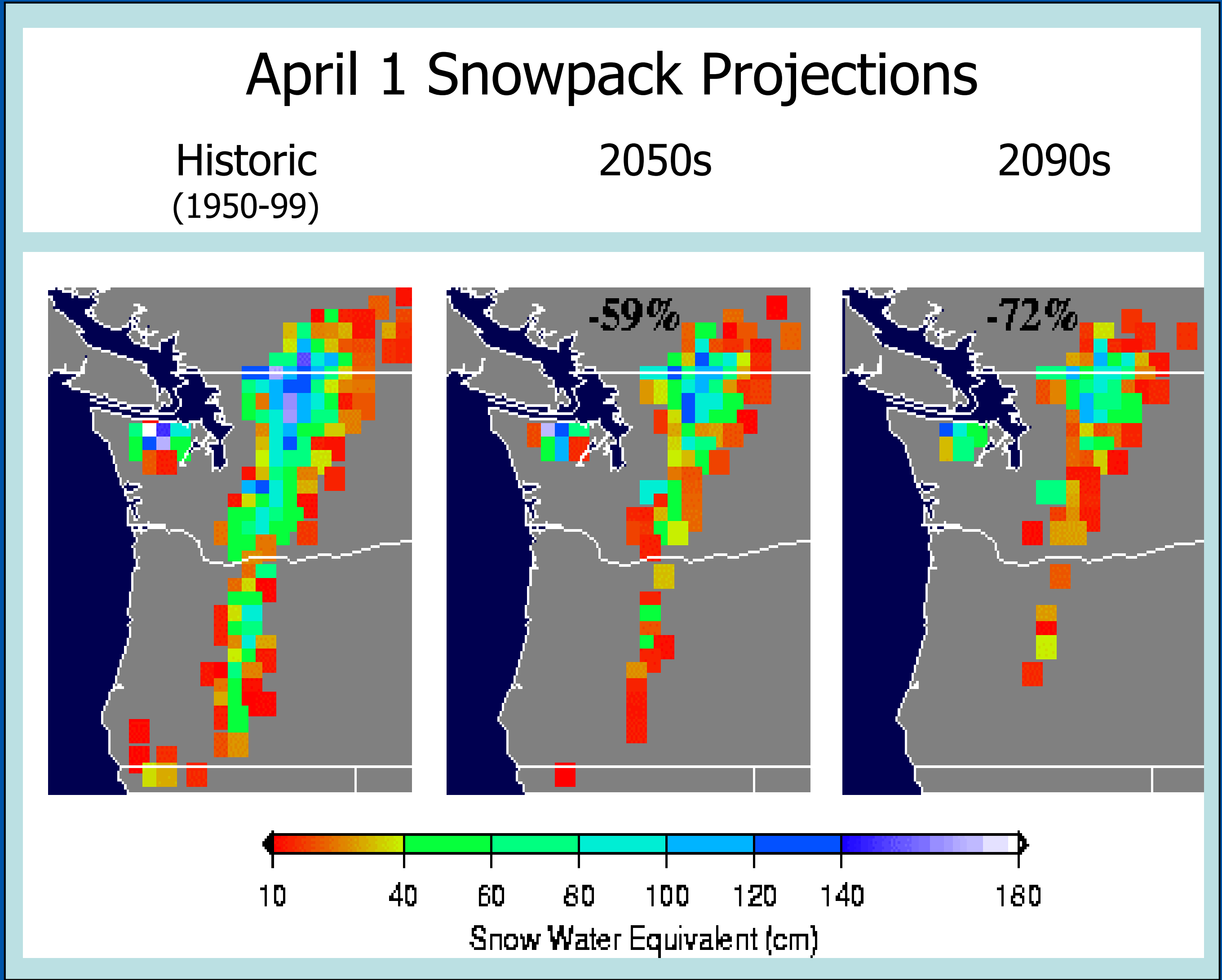
- Large warming
- Wetter winters, wetter/drier summers

Changes in the water cycle:

- ≠ winter runoff & streamflow
- Ø snowpack accumulation, spring (peak), summer, fall streamflows – even with winter precipitation
- earlier peak flows, longer time between snowmelt & fall rains

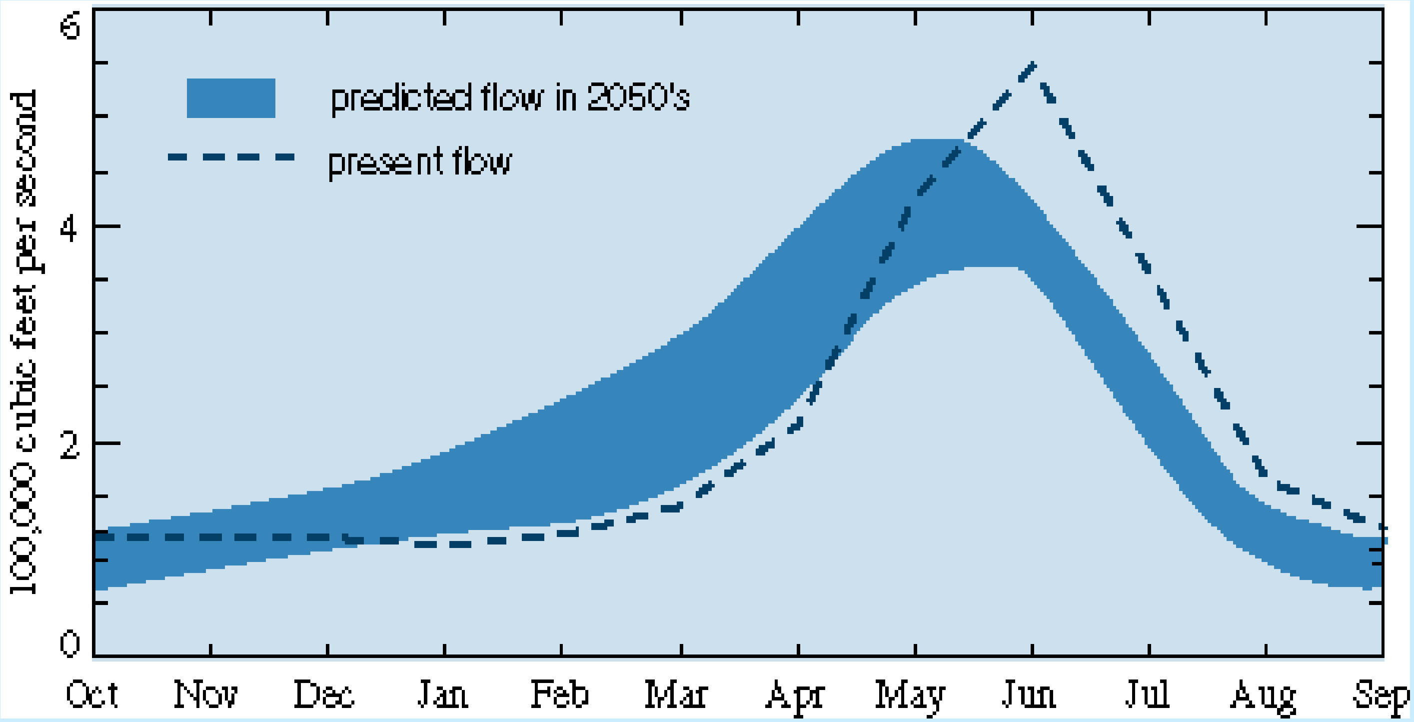
The Main Impact: Less Snow





Provided by Andy Wood and Dennis Lettenmaier, UW Civil Engineering
Accelerated Climate Prediction Initiative, a UW-SIO-PNNL collaboration

Changes in the Water Cycle



Naturalized Columbia River flow - the Dalles, OR.

Less snow, earlier melt: less water in summer

- irrigation
- urban uses
- fisheries protection
- energy production

Warmer temperatures: more water in winter

- more hydropower production
- flooding

Varying sensitivities:

Increasing sensitivity

snow-melt basins, $T_{winter} >> 0° C$

snow-melt basins, $T_{winter} > 0° C$

transient snow basins, T_{winter} @ $0° C$

PNW water systems:

- relatively little reservoir storage
- strong reliance on mountain snowpack
- sensitive to changes in seasonal streamflow patterns

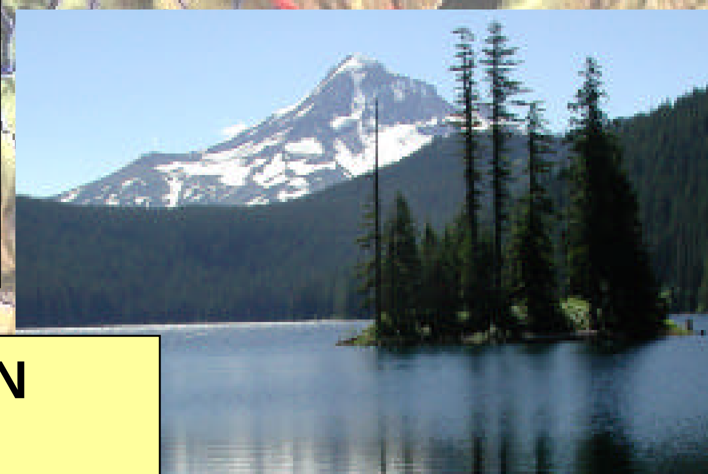
Implications for PNW water resources:

- ≠ frequency of summer low-flow events
- ≠ competition among water users

Climate Change Impacts on Portland, Oregon

Palmer & Hahn, in prep.

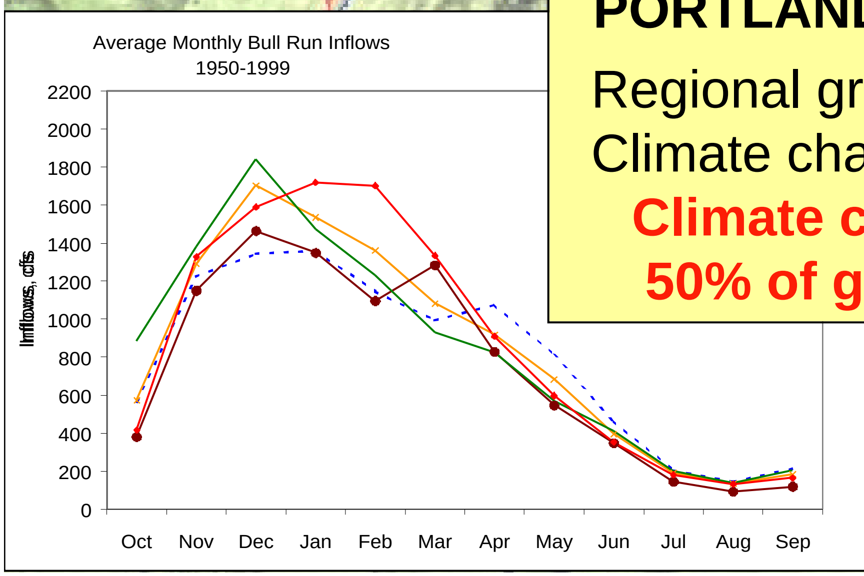
- More winter streamflow
- Less spring/summer streamflow
- Increased demands

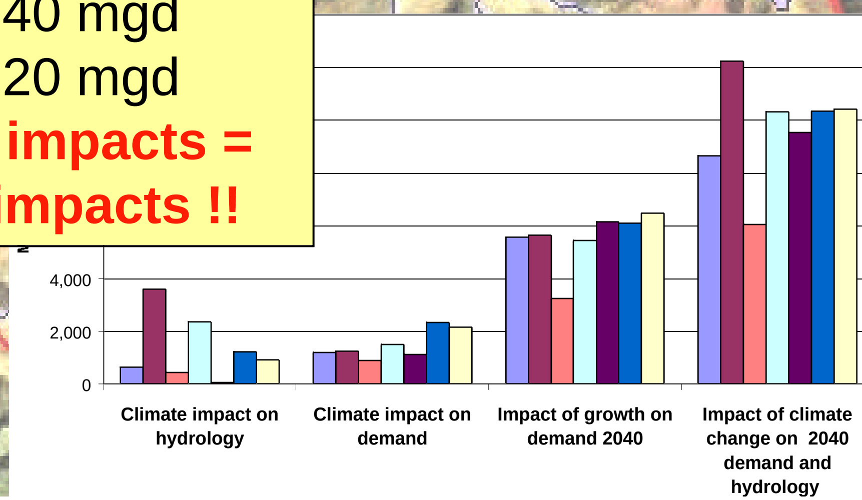


2040s WATER NEEDS IN PORTLAND (OR):

Regional growth: +40 mgd
Climate change: +20 mgd

Climate change impacts = 50% of growth impacts !!





Timing of significant changes:

~20 years: hydrologic changes in transient watersheds

[Cascade mountains and southern interior of the Columbia River basin (e.g., Snake River)]

40-50 years: hydrologic changes in snow-melt dominated systems

[northern headwaters of the Columbia River]

30-50 years: to change water resources systems

PNW policy makers and water management agencies should start planning for potential climate change now

Building Bridges Between Scientific Research Results and Policy Decisions

- **Models →** increasing understanding of coupling between natural and social systems aids in managing complexity
- **Scenarios →** perception of alternative pathways
- **Risk assessments →** formulating bottom lines
- **Options →** expand via identification and evaluation
- **Decision support tools →** better management

Recognizing the Mis-match: Different Tools, Different Objectives

Academic Research

Resource Management

- Climate Impact Assessments
- Coupled Models (climate + hydrologic + water mgmt)
- Innovation

- Formal Planning Exercises
- Limited Resources (financial & technical)
- Institutional Resistance to Change, Risk Aversion

Planning for climate change

Stakeholders requested:

- Climate change information for use in existing planning models
- Case studies of incorporating climate change projections into basin planning

Requirements of climate change information:

- more detailed, small scale information (catchment, watershed)
- must be “easy to apply to the problem at hand”

Climate change information must be appropriately tailored to the existing framework for planning & decision making.

Characterizing existing planning frameworks

Decision calendars:

- When/how are decisions made?
  - Specific (in-house) water resources models/tools
  - Historical streamflow record
  - Specific locations for specific time periods
- Where is climate information relevant to decisions?

Example: Columbia basin operating periods

1. Fixed period (Aug-Dec)

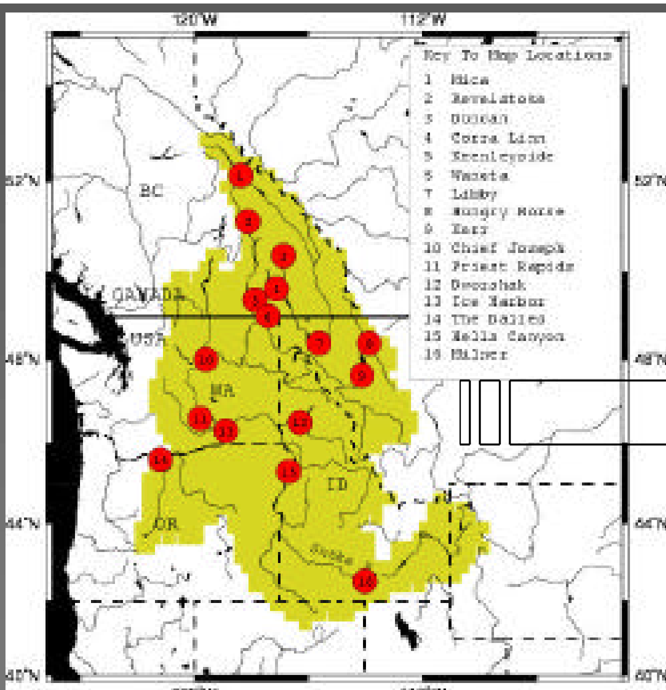
Assume the worst about spring inflow

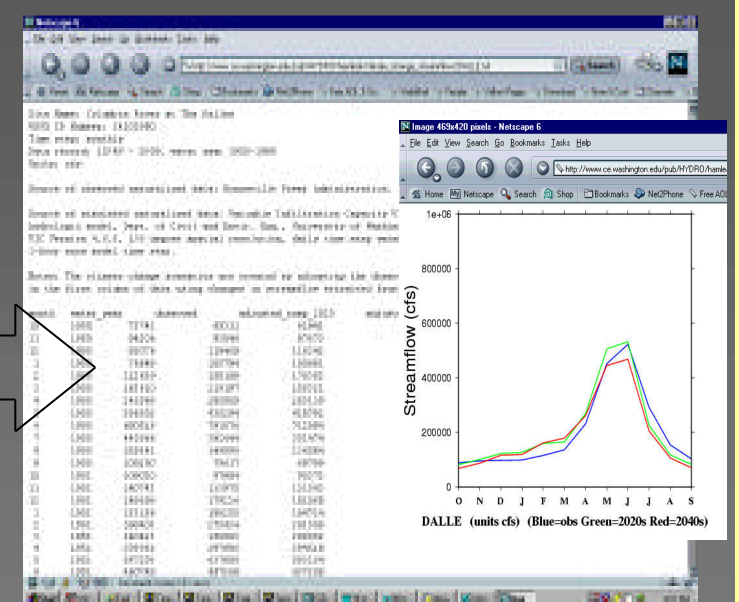
2. Variable period (Jan-Jul)

Use snowpack measurements to estimate spring inflow

Planning for climate change: Scenarios of future streamflow

Remove hydrologic model bias to produce climate change streamflow scenarios that can be substituted for the historical streamflow time series used in water resources planning





Web-based scenario tool provides free access to data

Partners:

Northwest Power Planning Council

Idaho Dept of Water Resources

Summary

Climate change information for water resources planning:

- Outreach experiences highlighted the need to inject climate change information into ***existing*** planning activities
- Climate change streamflow scenarios (produced by perturbing the observed historic streamflow record) can be directly used in existing critical period planning processes
- These scenarios provide a simple, low cost method for regional agencies to assess vulnerability to climate change

Effectively bridging the gap between science and policy requires:

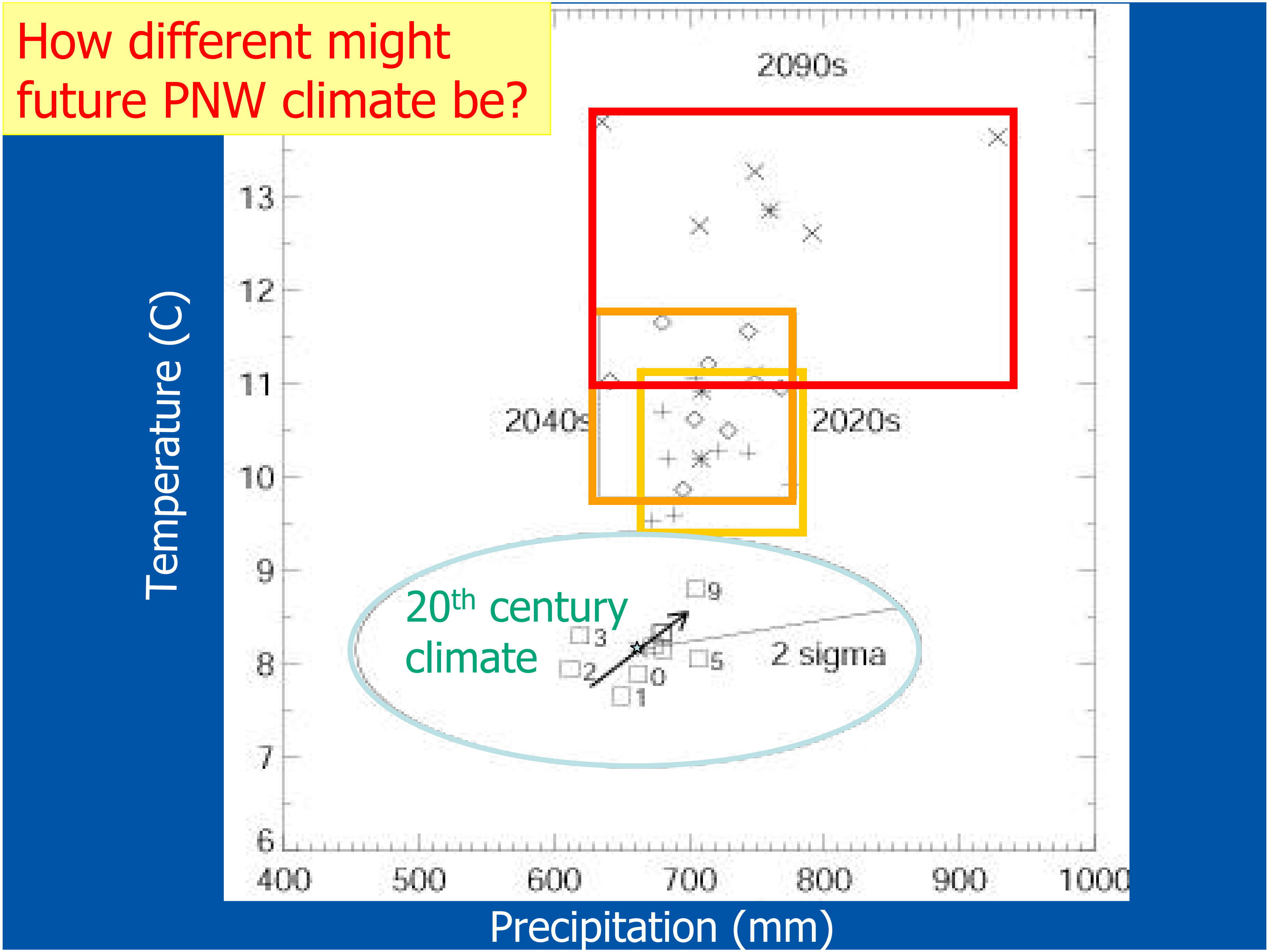
- Making the science ***useful*** to and ***useable*** by decision makers
- Sustained interaction between scientists and stakeholders
- Providing tools to help empty those inboxes

"In areas like climate change, scientific exploration and practical application must occur simultaneously. They tend to influence and become entangled with each other."

Kates et al. 2001

Resources

- Climate Impacts Group, University of Washington: www.cses.washington.edu
- Other RISA projects: www.ogp.noaa.gov/risa
- Jacobs, K. ND. ***Connecting Science, Policy, and Decision-making: A handbook for researchers and science agencies***. A report of the University Corporation for Atmospheric Research (NCAR) produced by the NOAA Office of Global Programs.
- Kates et al. 2001. Sustainability Science. ***Science*** 292: 641-642.
- Pielke, R., Jr. and D. Sarewitz. 2002. Wanted: Scientific leadership on climate. ***Issues in Science and Technology*** Winter 2002-2003: 27-30.


How different might future PNW climate be?
2090s
2040s
2020s
20th century climate
2 sigma
Temperature (C)
Precipitation (mm)
13
12
11
10
9
8
7
6
400
500
600
700
800
900
1000

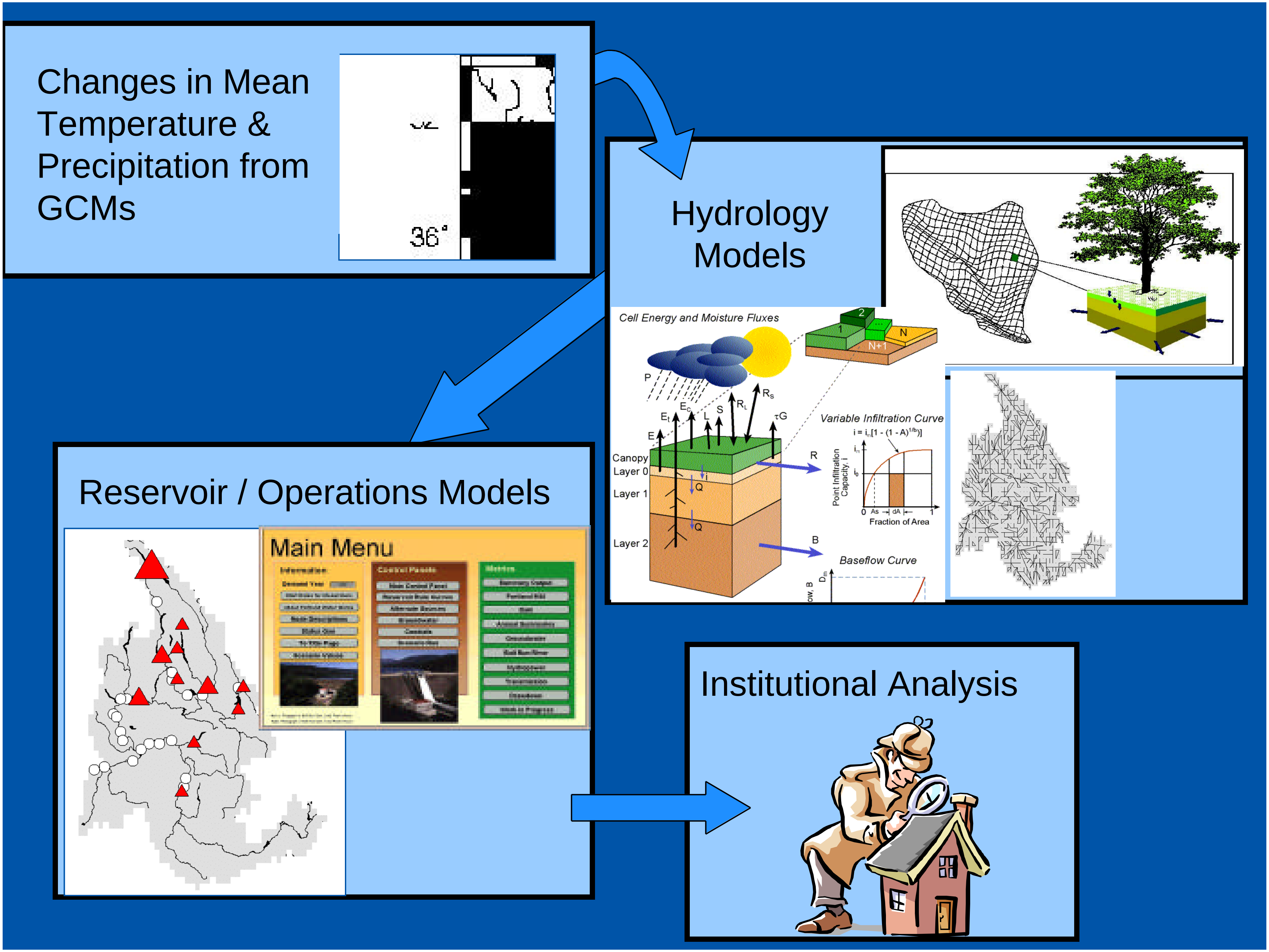
Climate change in the PNW: 2040s

	Temperature		Precipitation	
	summer	winter	summer	winter
low	+1.5°C	+0.9°C	-7%	-2%
mean	+2.1°C	+2.0°C	+2%	+9%
high	+2.8°C	+3.0°C	+9%	+22%

Warmer, wetter winters.

Warmer summers.

Estimated climate change from 20th century to the 2040s using 8 climate model scenarios ("summer"=April-September, "winter" = October-March).



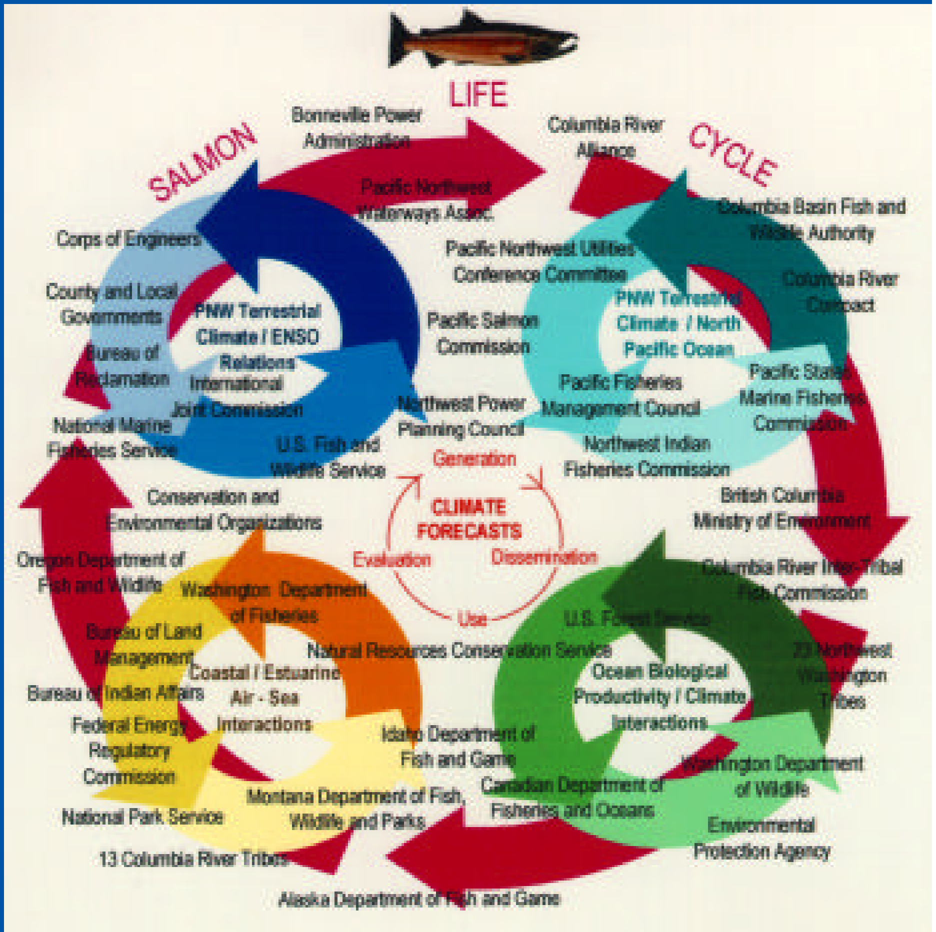
Changes in Mean Temperature & Precipitation from GCMs
36°
Hydrology Models
Cell Energy and Moisture Fluxes
Canopy
Layer 0
Layer 1
Layer 2
Variable Infiltration Curve
Fraction of Area
Baseflow Curve
Reservoir / Operations Models
Main Menu
Institutional Analysis

Understanding the Institutional Context of Decisions

Mapping institutional frameworks

- Identify players
- Characterize laws, treaties, rules and constraints
- Determine interactions
- Analyze individual institutions

Methods: interviews, institutional analysis



Pulwarty & Redmond 1997

Research Approach

- **Retrospective -** establish past impacts of climate and societal responses
- **Interdisciplinary & integrated -** whole greater than the sum of parts
- **Contextual -** climate one of many factors influencing natural resources

Important Lessons

1. A well-coordinated outreach effort is required, to:

- introduce stakeholders to the potential role of climate change information in water resources management
- facilitate information transfer from the research context to practical water management applications
- understand current approaches to planning

Planning for climate change

1995:

Few managers

– Saw a role for climate information in planning & decision making

– Recognized predictability of climate (variability or change)

–Possessed a contextual framework for applying climate change information

1997:

- First regional-scale examination of climate change impacts on PNW
- Most stakeholders unfamiliar with potential impacts of climate change & unprepared to use this type of information
- Spatial scale of interest << scale of analysis

1997-2001:

- Increasingly focused climate change research
- Intensive region-wide outreach
- Shift in attitudes: widespread official recognition of regional water resources systems' lack of capacity to meet present & anticipated future demands even without climate change!
- Out in front: Portland & Seattle

Planning for climate change

2001 high level water policy workshop:

- Climate change = potentially significant threat to regional water resources
- Climate change information = critical to future planning
- Significant step forward!

Stakeholders requested:

- Climate change information for use in existing planning models
- Case studies of incorporating climate change projections into basin planning

Requirements of climate change information:

- more detailed, small scale information (catchment, watershed)
- must be "easy to apply to the problem at hand"